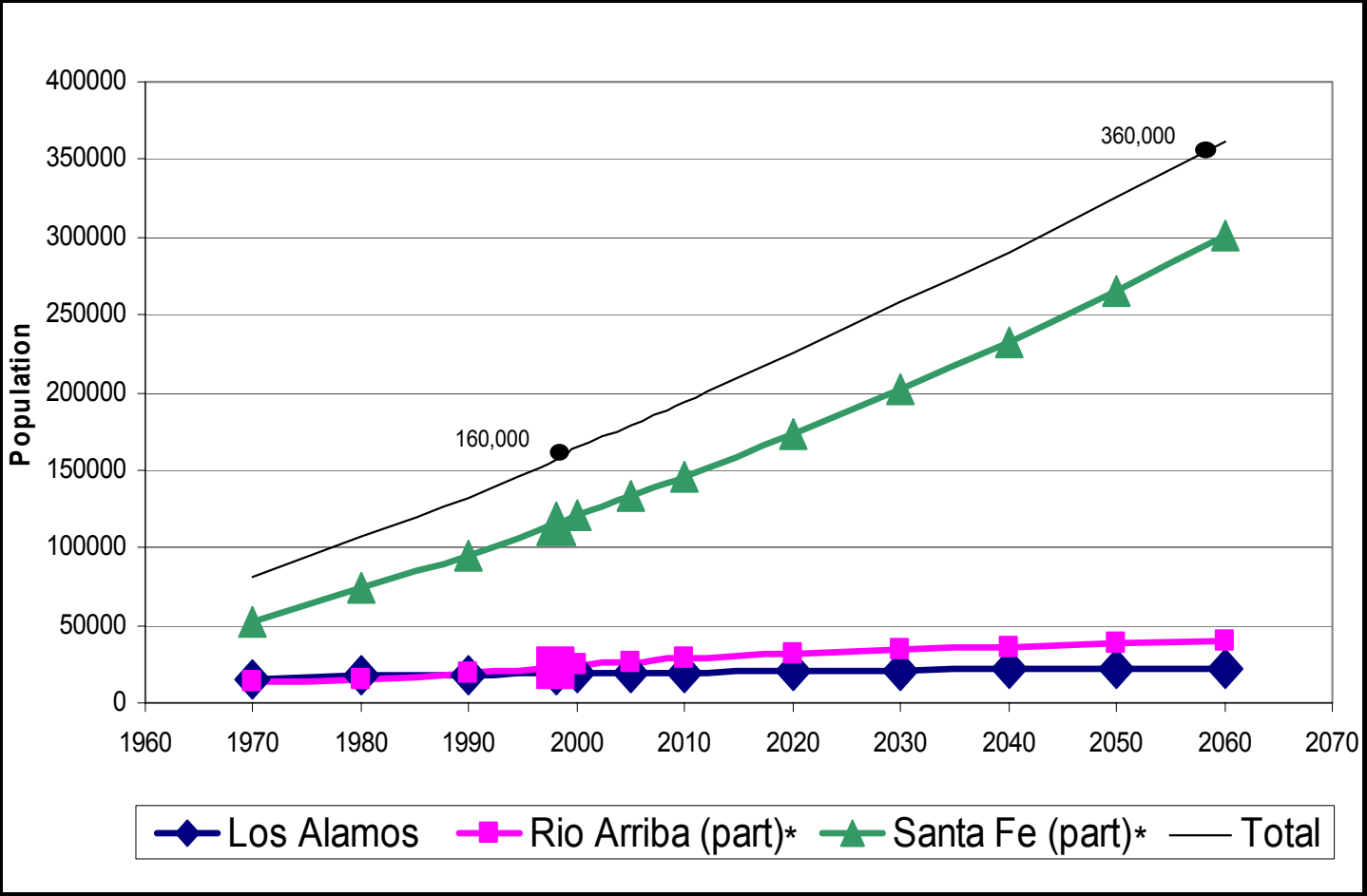
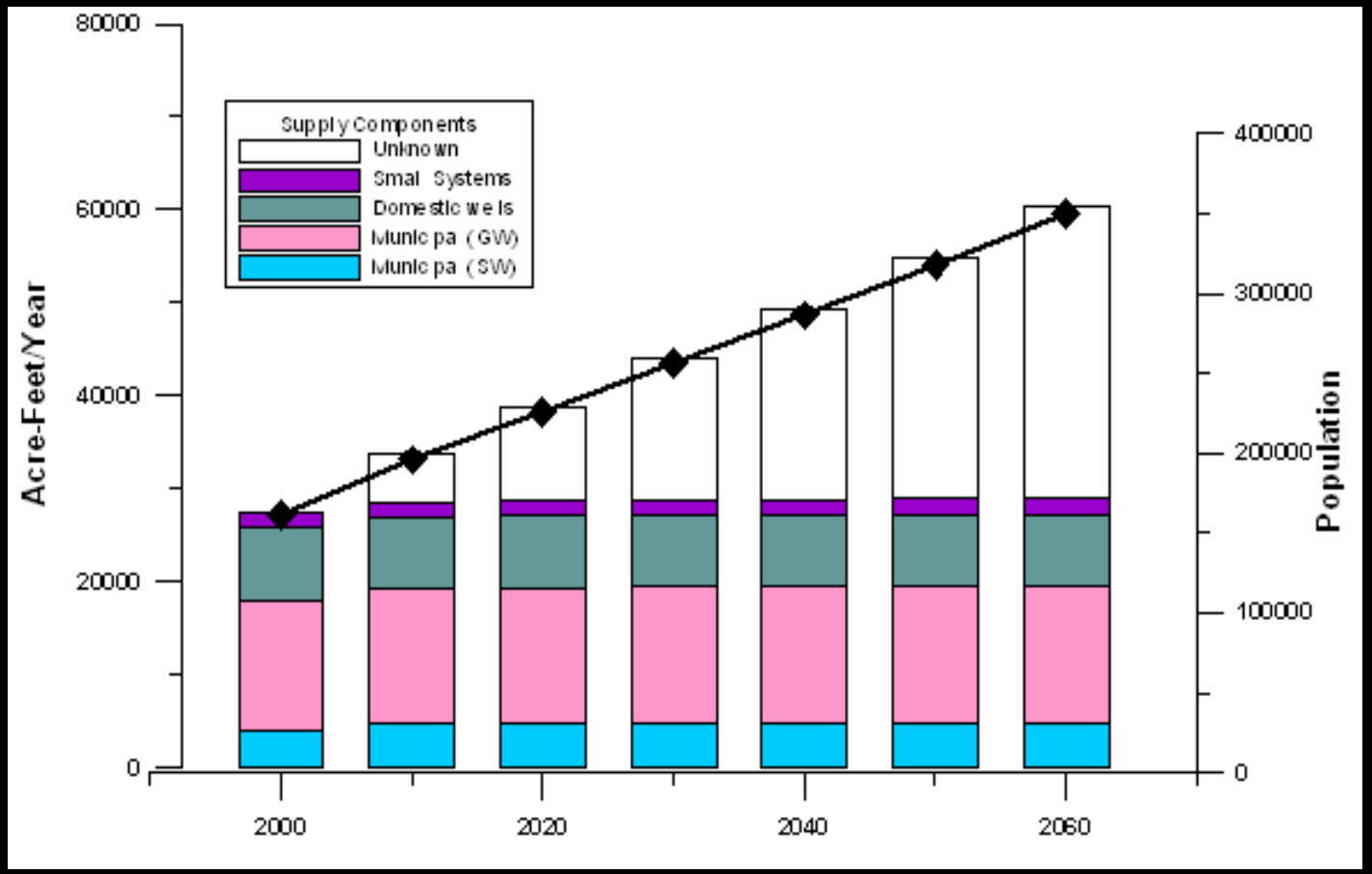
A Cloud Seeding Pilot Project in the Jemez y Sangre Area - More Water Now

Presentation by Sigmund Silber
ssilber1@juno.com

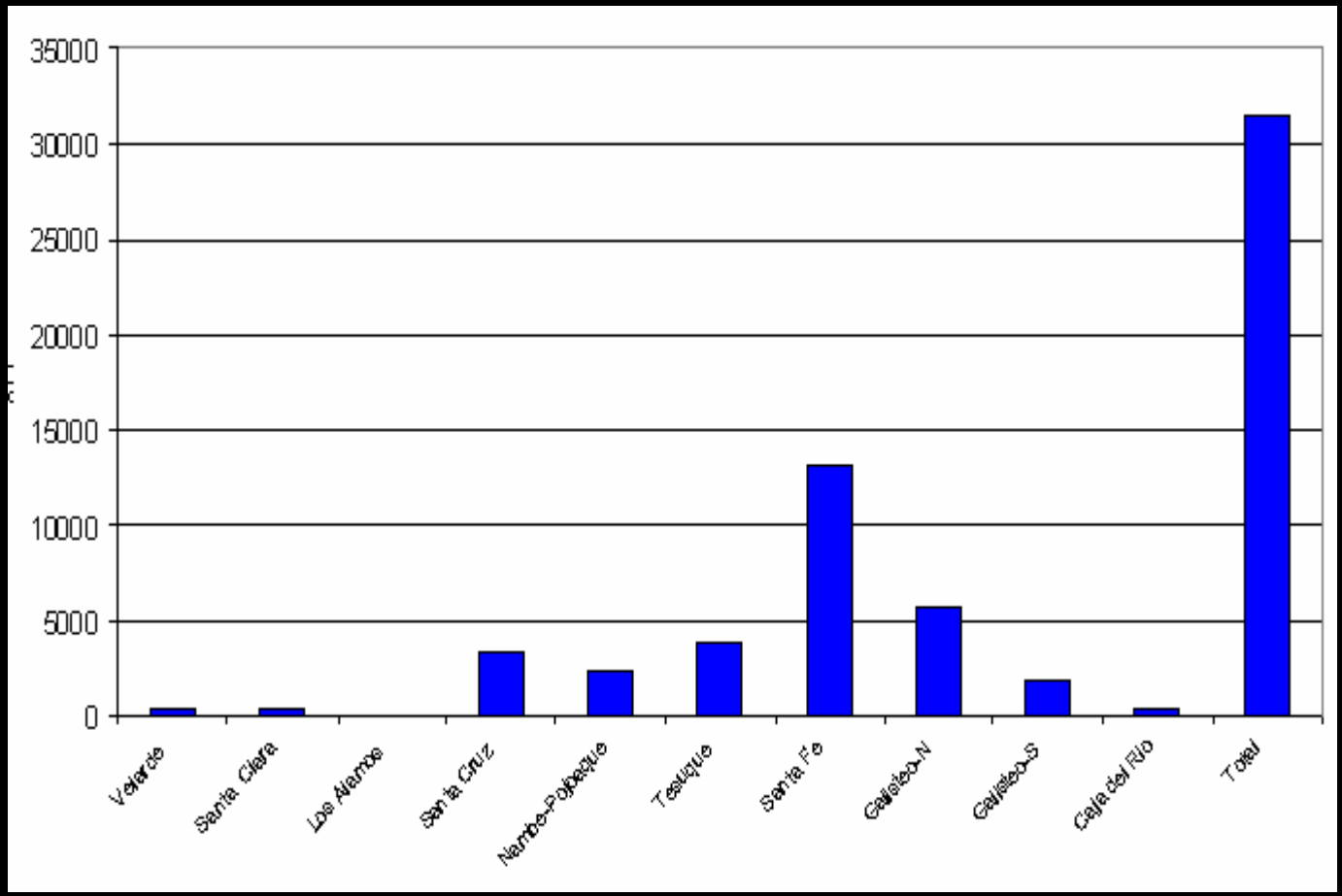
Projected Population Growth



Developing Gap Between Supply and Demand



2060 Deficit by Watershed



Our Goal from Cloud Seeding

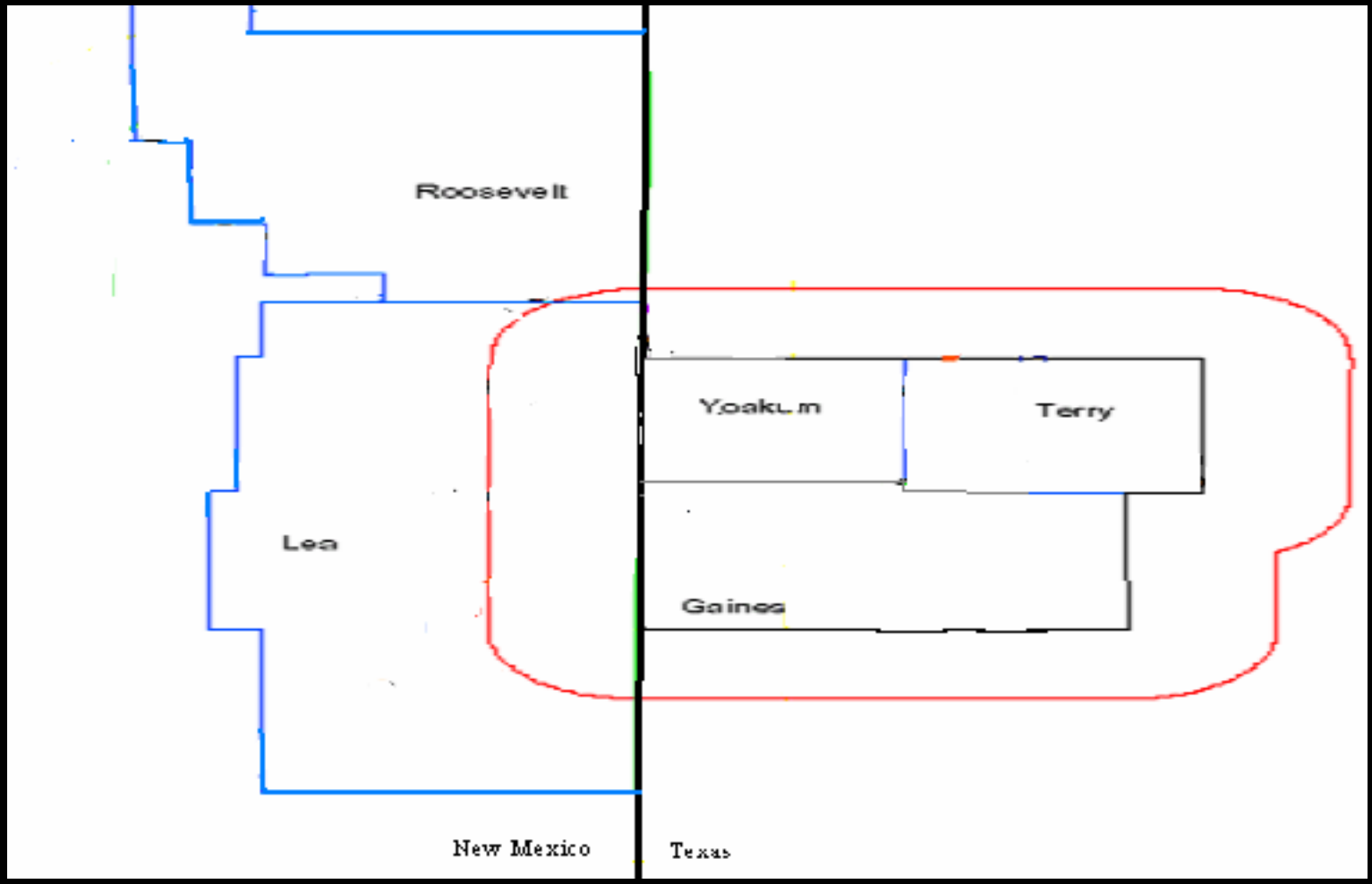
Project Goals

- Enhanced Precipitation
- Usable Water
- Low Cost Water
- Community Support

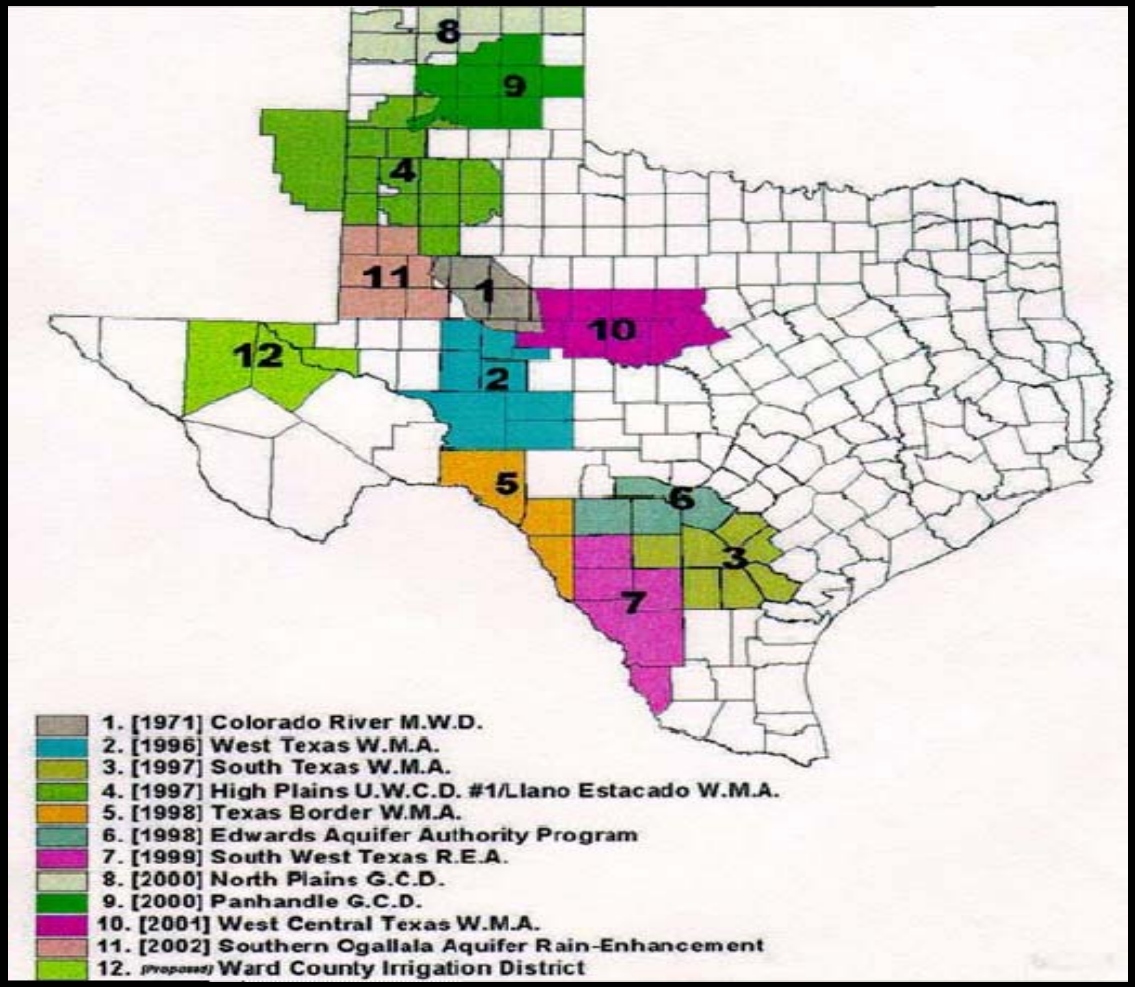
Jemez Seeding 1968 - 1972

- Seeding periods selected at random
- 13% Increase in precip for seeded areas and sessions
- Potential increase of 30% with full seeding
- Some indication of downwind increases in precipitation

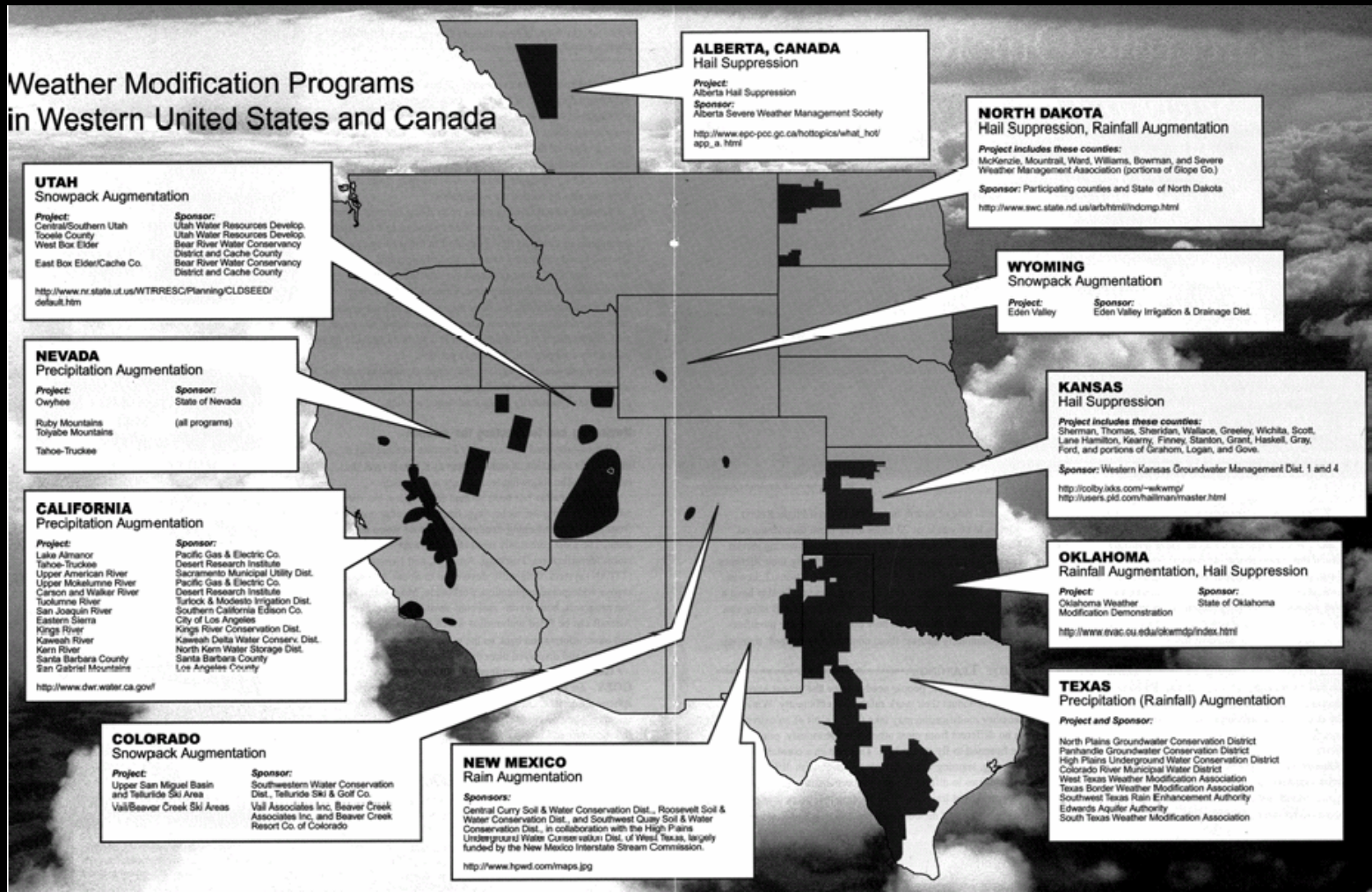
Cloud Seeding in Southeast New Mexico



Seeding in Texas



Most Western States are Seeding



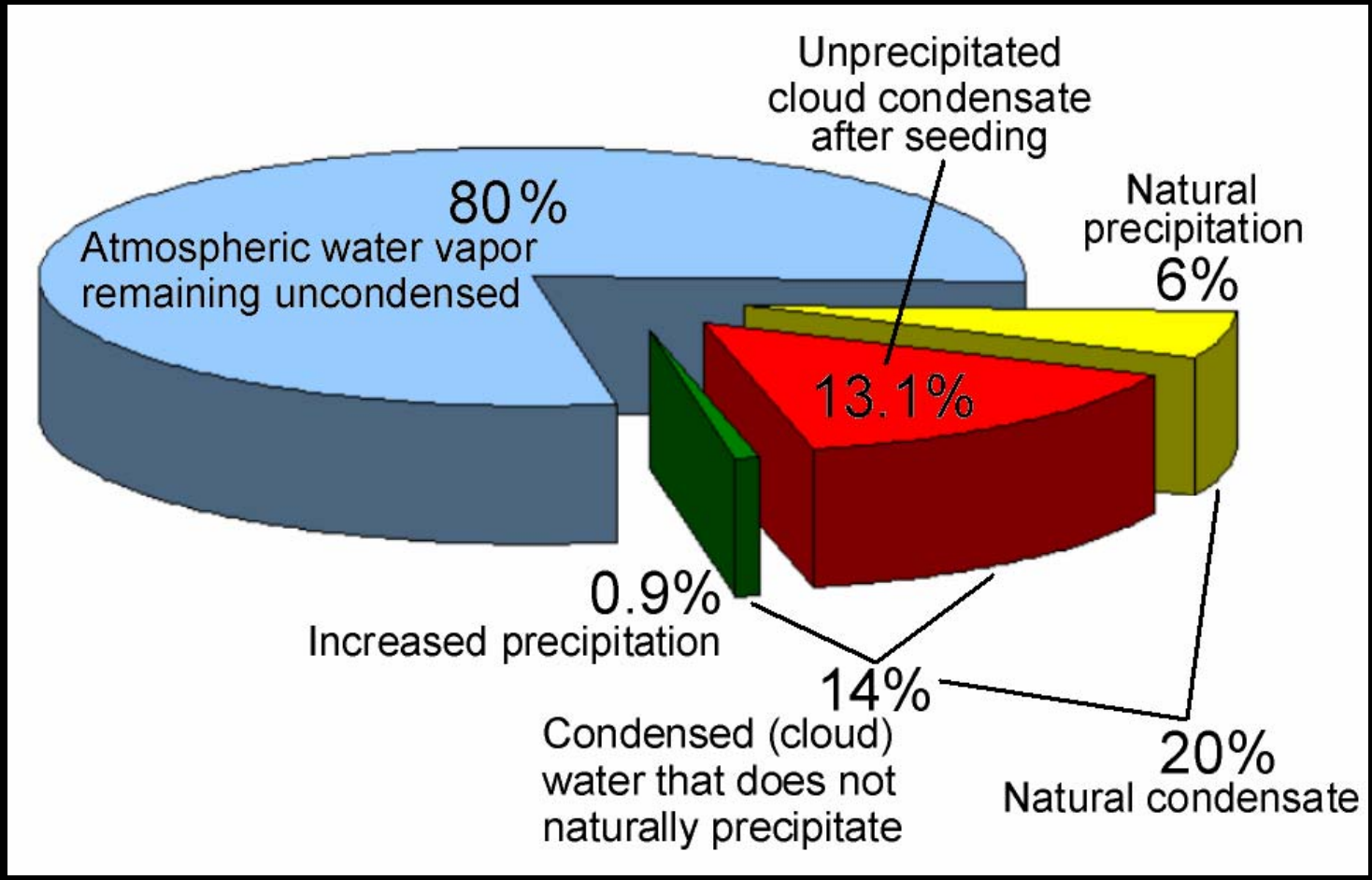
Why Cloud Seeding is Needed

- Inefficient rain/snow processes
- Man has modified rain/snow processes
- Targeted precipitation is very usable

Inefficient rain/snow Processes

- Supercooled water may not precipitate
- Droplets too numerous and too small
- Updrafts not powerful enough for cloud to grow

Precipitation Inefficiencies - Graphic



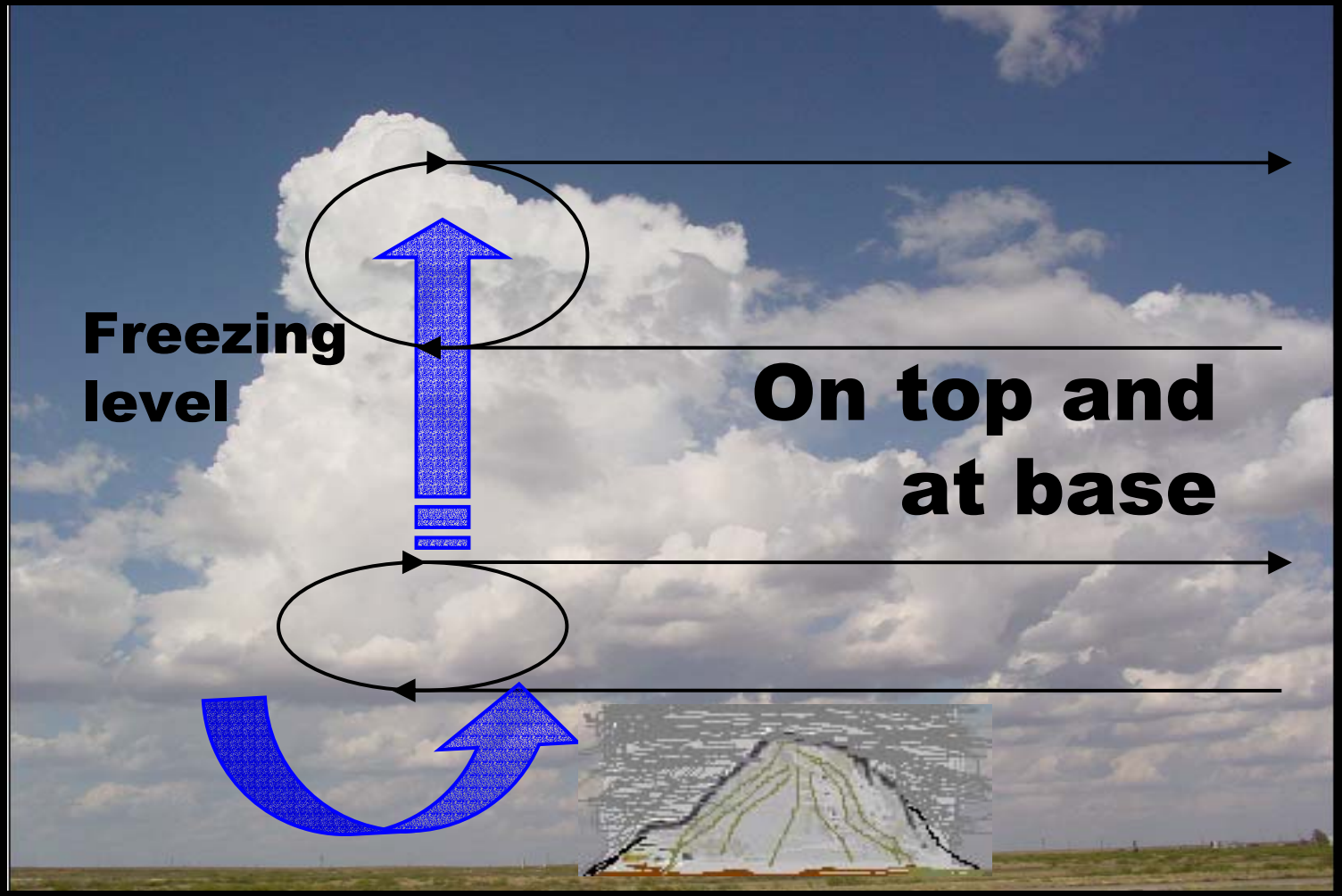
Precipitation Inefficiencies

- 20% of moisture ends up in clouds as droplets
- 30% of the available droplets precipitate. This is only 6% of the available moisture (30% of 20%)
- Goal of Cloud Seeding is to up the 30% to 35% and possibly increase the 20%

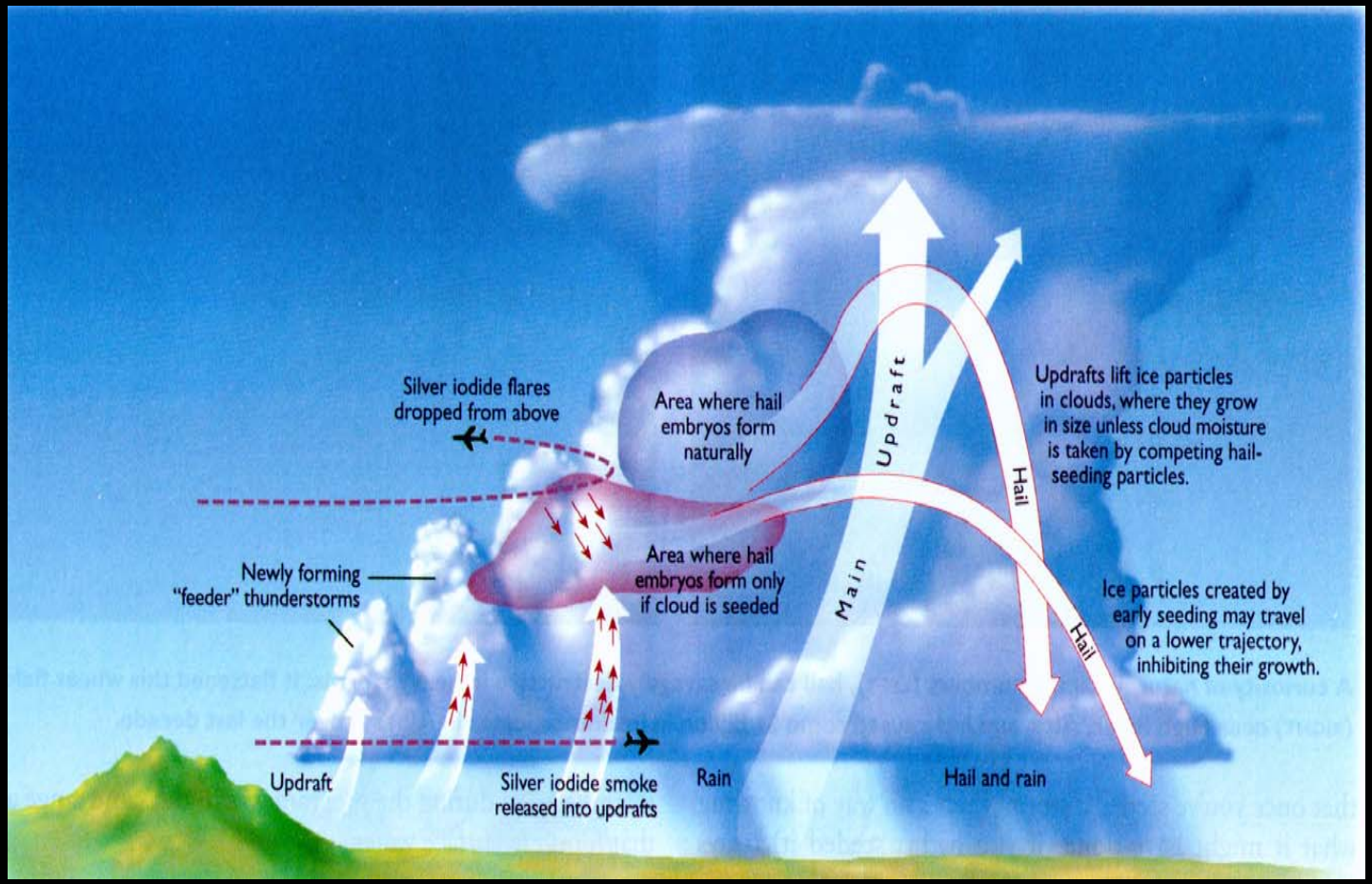
Cloud Seeding Solution

- Seeding agent to start supercooled water crystallizing
- Hygroscopic agents to stimulate collisions and coalescence
- Water crystallization releases heat fueling updrafts

Seeding Areas Within Cloud



Seeding Agent Delivery Strategies



Ground-based Generator

Ground-Based Flare Tree

January 21st/22nd 2004 Workshop

- 13 Experts participated in the program
- 84 Attendees
- Consensus to proceed with pilot program

FOR MORE INFO...

Proceedings of Jan 22nd/23rd 2004 Workshop

Two Illustrative Scenarios

Acres Seeded	Seasonal Precip	Acre-Feet of Precip	10% Increase	15% Increase
100,000	14 Inches	116,667	11,667	17,500
200,000	10 Inches	200,000	20,000	30,000

Preliminary Economic Analysis 20,000 AFY of Water

	Stream Runoff	Aquifer Recharge	ET	Total
Percentage	60%	15%	25%	100%
Acre Feet	12,000	3,000	5,000	20,000
Value AFY	$500	$500	0	$375
Value or Replacement Cost	$6MM	$1.5MM	$0	$7.5MM

Additional Hard to Quantify Benefits

- Additional precipitation at lower elevations
- Additional precipitation east of target area in the Sangres
- Recreational and tourism value of snow
- Fire suppression value of additional precipitation
- Benefits to wildlife and vegetation

Comparisons re Cost of Water

- Cloud seeding water at $25 AFY
- Aamodt water at $1,200 AFY (includes delivery to your house)
- SJC water at $1,200 AFY
- Santa Fe City Water at $1,300 AFY
- Desal water at $1,500 AFY FOB Willard.
- Perrier water at XXXX AFY

Schedule: Optimistic Case

- Cloud Inventory Summer 2004
- Cloud in-situ measurements Nov/Dec 2004
- Legislature Appropriation Jan/Feb 2005
- Funds Available July 2005
- Seeding Begins November 2005

Schedule Slower Case

- Legislature Appropriation Jan/Feb 2005
- Funds Available July 2005
- Cloud Inventory Summer 2005
- Cloud in-situ measurements Nov/Dec 2005 or Jan - March 2006
- Seeding Begins November 2006

Factors Determining Rate of Progress

- Ability to fund Pre-seeding Analysis in 2004
- Federal Support/but not an EIS
- State Legislative Support
- Broad support from stakeholders
- Creation of Regional Organization /Coalition to Conduct Cloud Seeding
- Possible tie in with Aamodt Settlement

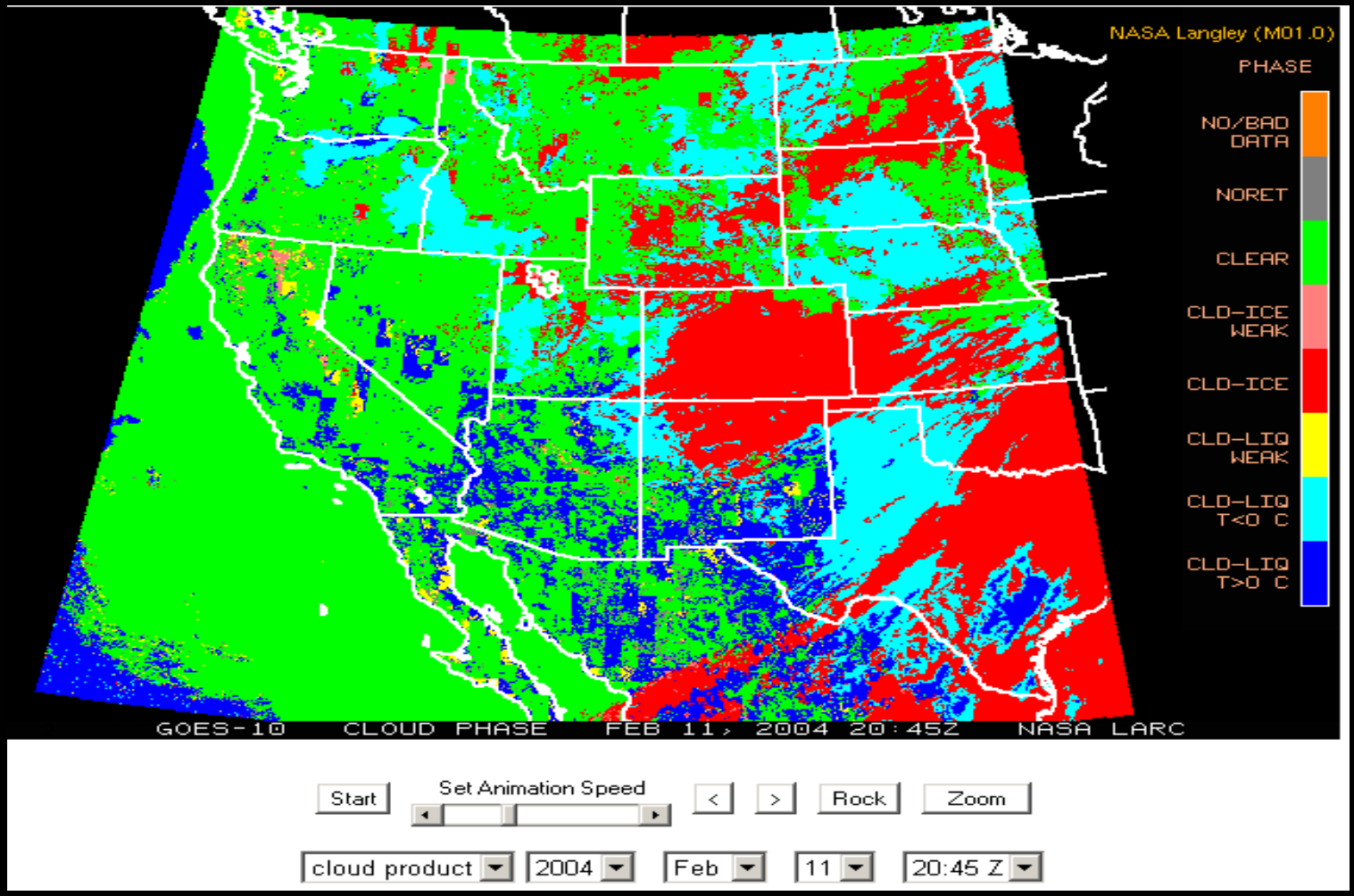
Proposed Pre-seeding Analysis

- Confirm that project is feasible: this part of analysis is state-wide
- Begin design of cloud seeding project
- Advance the start date of any project by accomplishing this work in 2004
- Cost approximately $95,000
- Need private sector and city/county participation

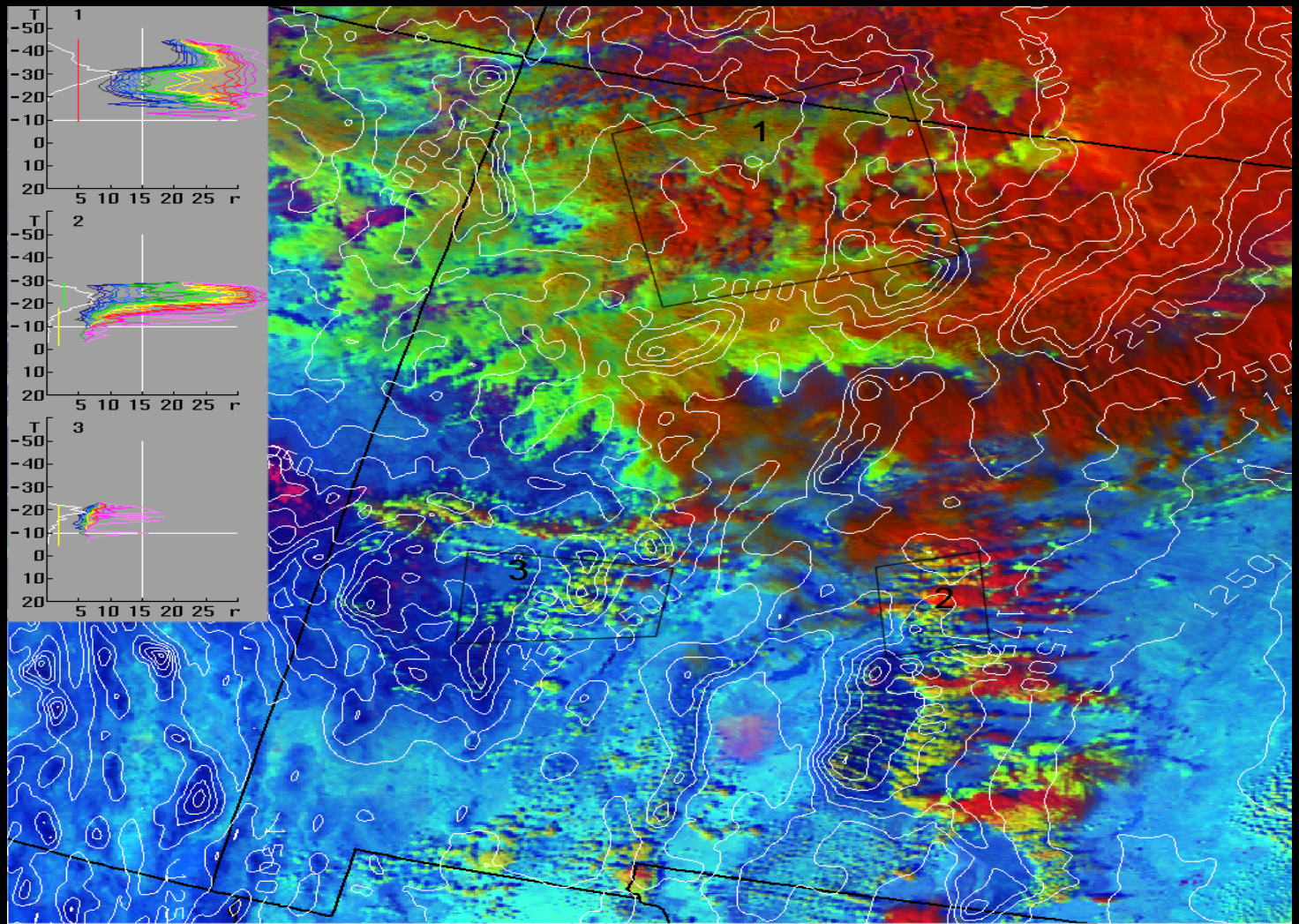
Components of Pre-seeding Analysis

- Historical Cloud Inventory
- In-Cloud Measurements
- Modeling of Seeding Operations

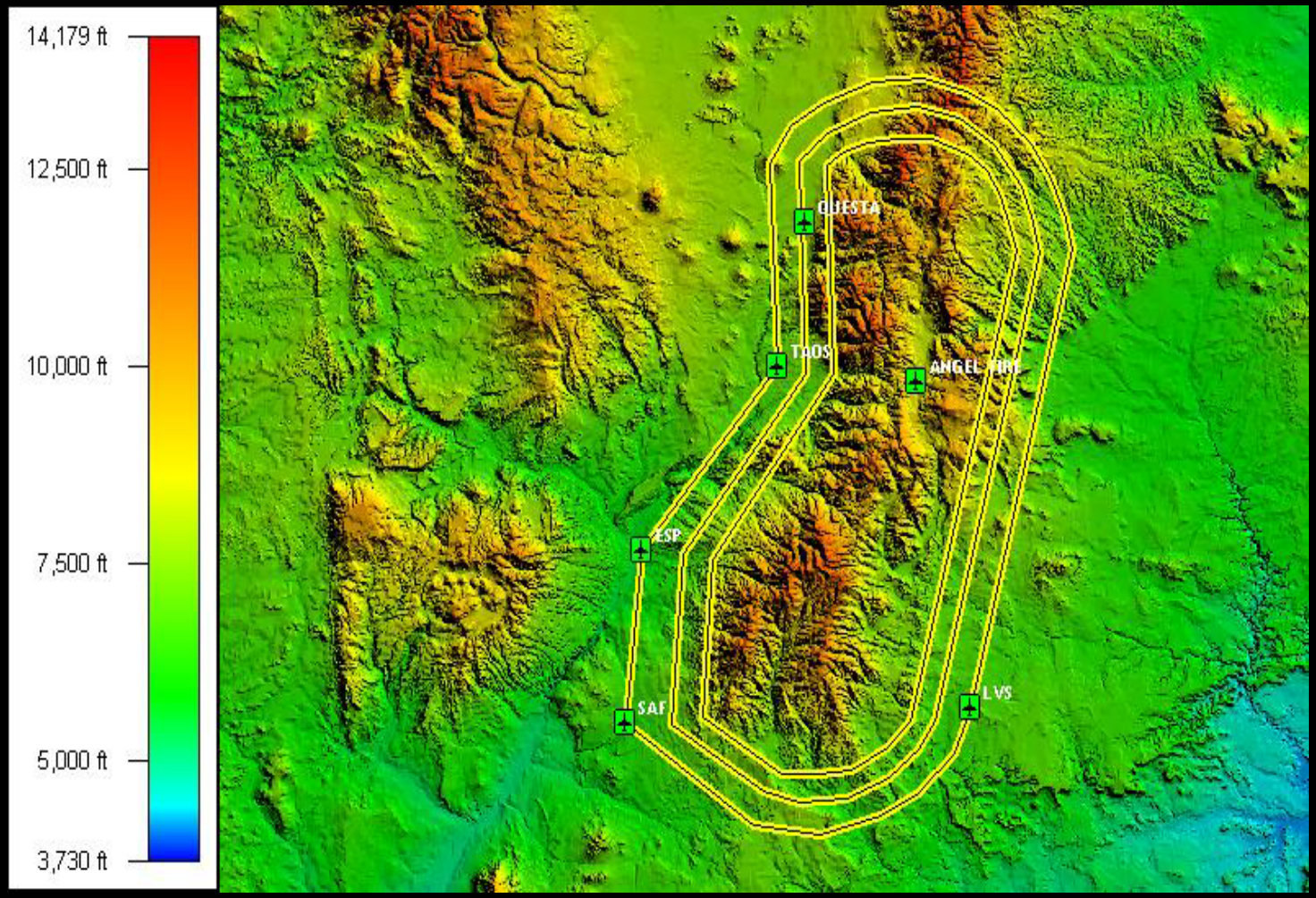
Satellite Icing Imagery



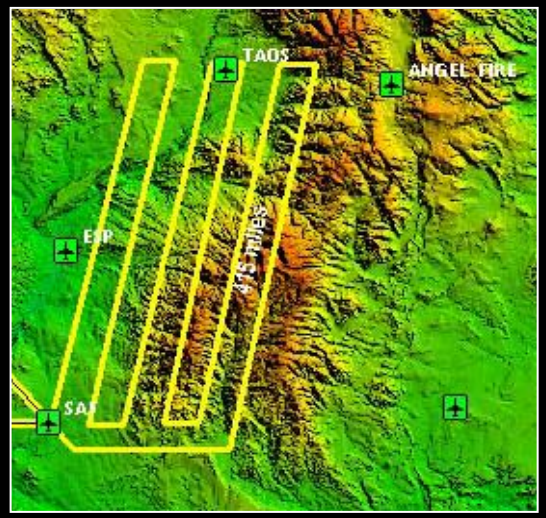
Satellite Imagery with More Resolution



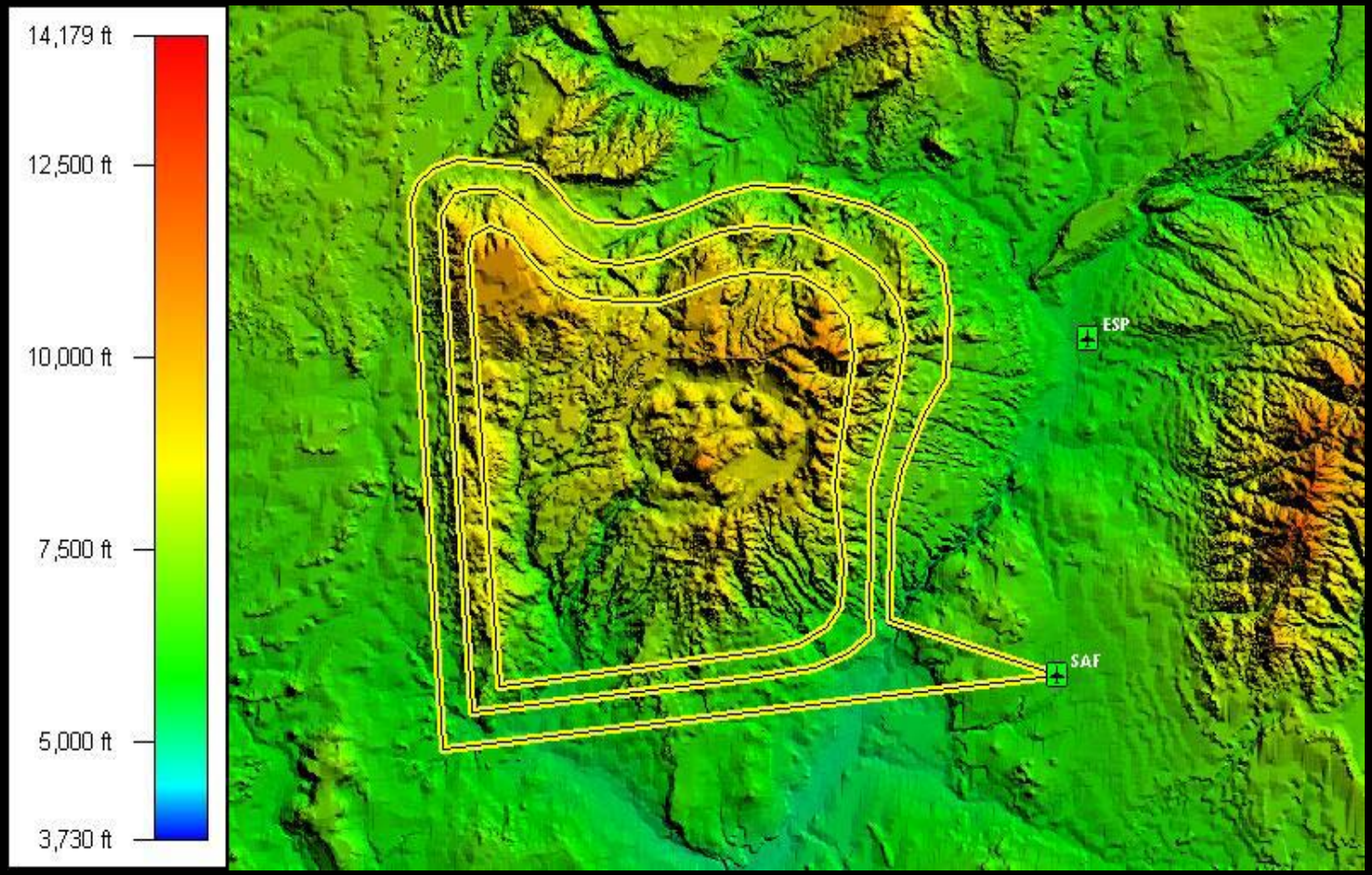
Possible Sangres in-cloud Flight Path



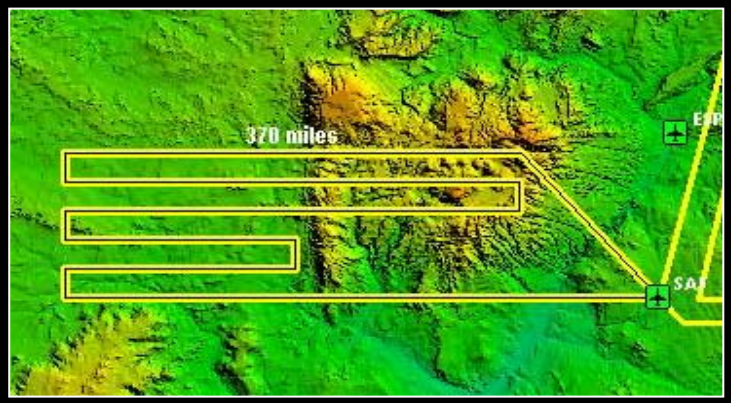
More Sangres Flight Paths



Possible Jemez in-cloud Flight Path



More Jemez Flight Paths



20kft
18kft
16kft
14kft
12000 ft
10000 ft
9000 ft
8000 ft
7000 ft
6000 ft
E
W
E
W
CLOUD BASE
50 mi
100 mi
150 mi
200 mi
250 mi
369 mi

The Plane…The Plane

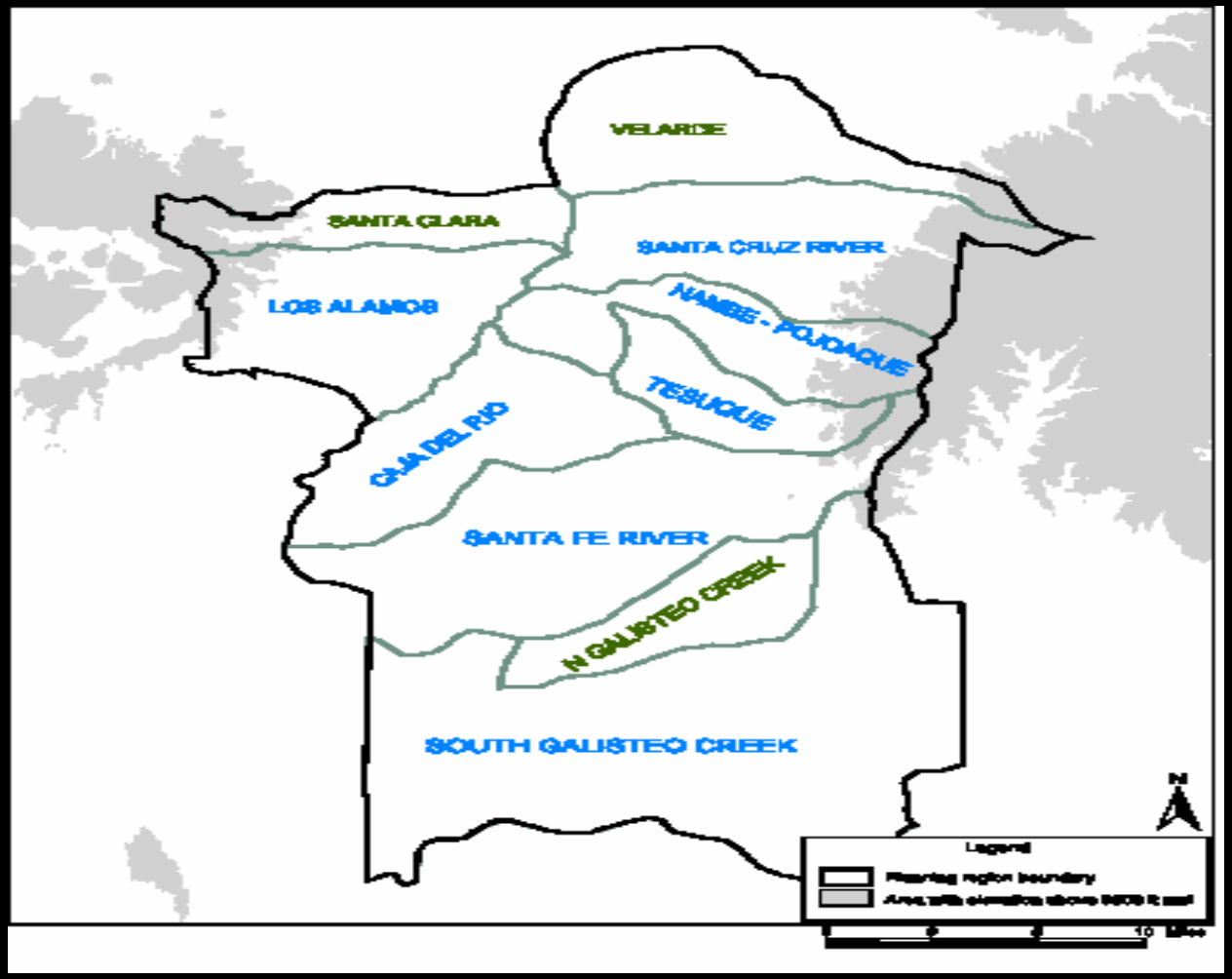
Modeling Objectives

- Plan the in-Cloud Flights
- Position ground based silver iodide burners: Is there positioning that will be effective?
- Identify additional targets other than the standard high-elevation areas

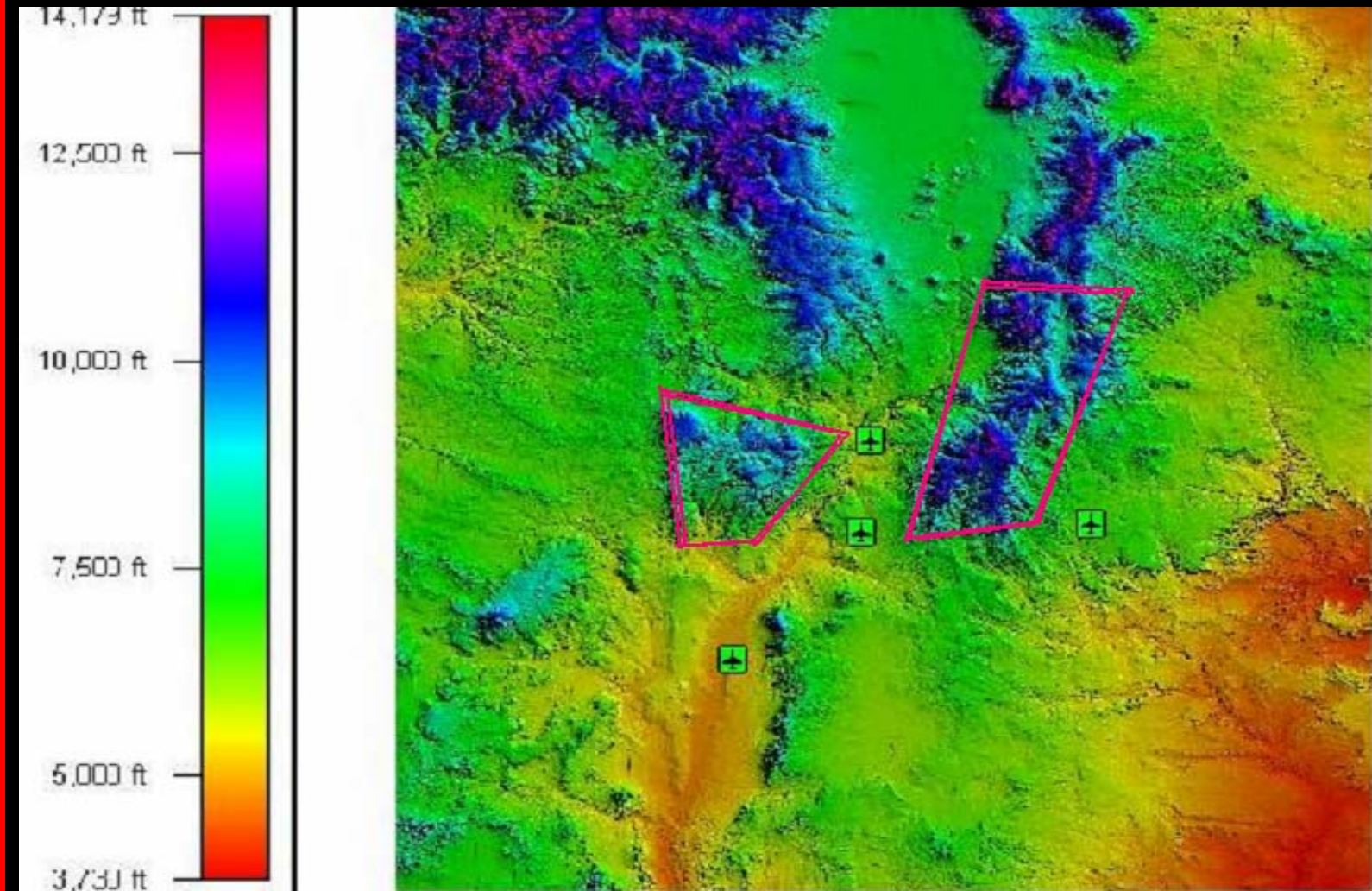
Possible Funding Sources

- Private Sector
- Cities and Counties
- State of NM
- Public Sector
  - Agencies
  - Aamodt
  - EPA Fines

Areas Above 9000 Feet



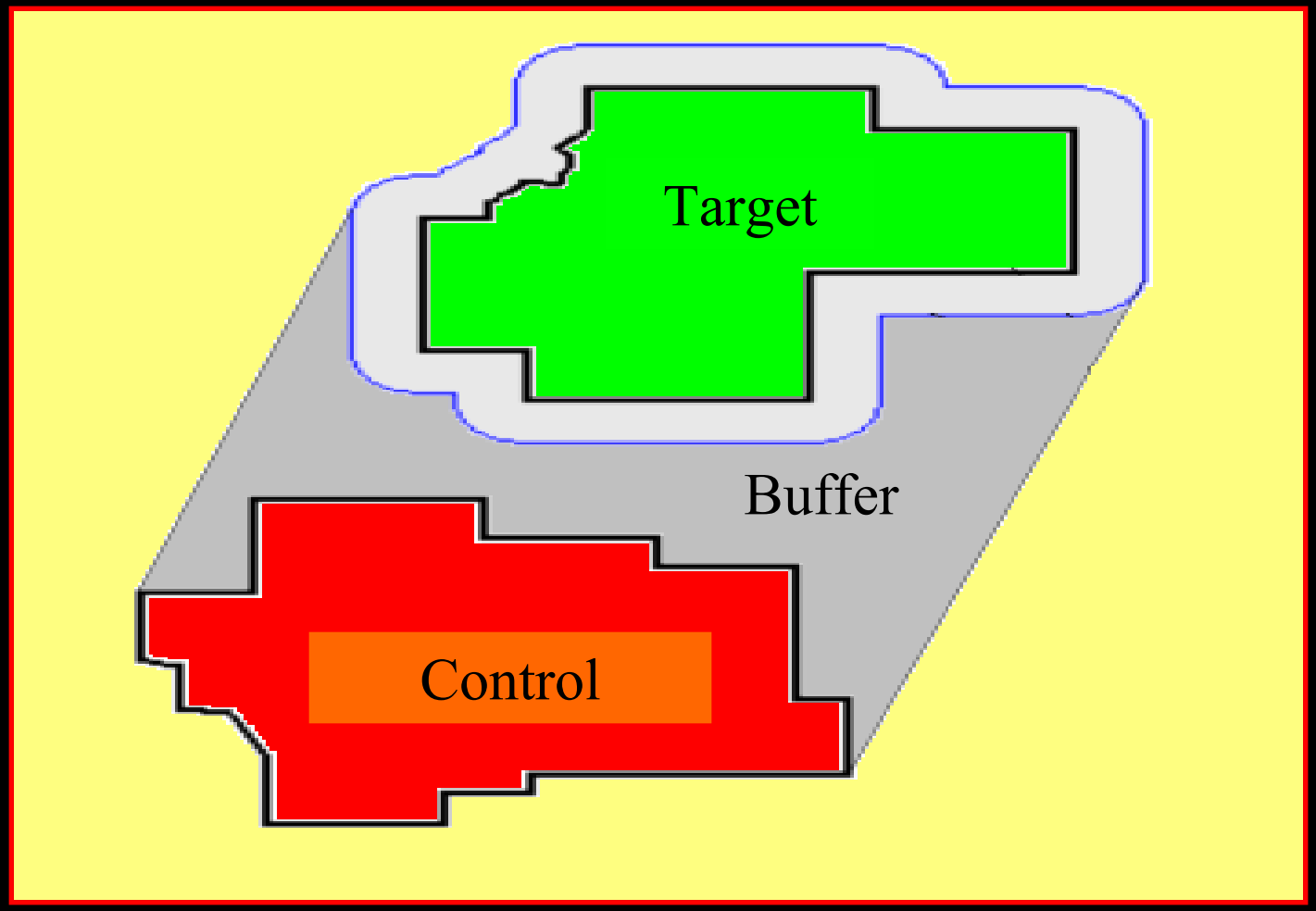
Possible Winter Seeding Target Area



Role of Assessment

- To know what additional precipitation was produced
- To provide confidence to the public that public funds were well spent
- To assure the scientific community that the project made scientific sense
- To allow year after year improvement in seeding approach

Target and Control Evaluation Method



Random Cloud Seeding Evaluation Method

VARIABLE	SEEDED	CONTROL	INCREASE (%)
Lifetime (min)	120	80	36
Area (km sq.)	69	56	36
Volume (km cu.)	286	246	30
Top height (km)	9.6	9.2	11
Max dBz	48	45	4
Top height of max dBz (km)	4.9	5.5	-11
Volume above 6km (km cu.)	104	87	30
Precip. Flux (m cu./s)	320	205	62
Precip. Mass (kton)	1909	978	86

Achieving Assessment Quality

- Needs to be independent of seeding operator
- Needs to be defined prior to seeding beginning
- Should include physical as well as statistical methods

Organizing to Get a Pilot Project Going